Proposal

For a Collaboration Meeting of CARINA (Challenges and Advanced Research In Nuclear Astrophysics) and JINA (Joint Institute for Nuclear Astrophysics) at the

ECT, Trento, Italy on

"Nuclear Physics Data Compilation for Nucleosynthesis Modeling"

1. **Tentative date of the meeting:** May – June 2007

2. **Proposed duration of the meeting:** 1 week

3. **Organizers:**

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4. Scientific Proposal

Over the last decade the field of nuclear astrophysics has emerged as one of the most important subdisciplines of nuclear physics. The main goal of the field is to identify the most important nucleosynthesis sites and model the dominant nucleosynthesis processes which have led to the origin of the chemical elements in our universe. A further goal is to describe the nuclear burning processes which govern the different stages of stellar evolution and which drive a large variety of cataclysmic explosion processes observed in our universe. This effort requires both extensive observational data bases on elemental and isotopic abundances which represent the critical observables against which we can test the results of theoretical modeling efforts of the various nucleosynthesis sites. There is a large variety of stellar and explosive nucleosynthesis scenarios, ranging from charged particle induced hydrogen, helium, and carbon burning in stars to explosive hydrogen, helium and heavy ion burning in novae, cataclysmic x-ray bursts and type I supernovae explosions. Heavy elements beyond iron are produced by neutron induced processes such

as the s-process in Asymptotic Giant Branch (AGB) stars or in core helium burning in massive red giant stars, or complementary to that by the r-process, a sequence of rapid neutron capture reactions which is expected to take place in the type II supernova shocks. These nucleosynthesis processes are complemented by photon induced processes such as Neon burning and Silicon burning during late stellar evolution and the p-process in the type I or type II supernovae. The reliable modeling of all these nucleosynthesis scenarios and the identification of the associated astrophysical sites requires detailed nuclear reaction and decay data. Over the years a multitude of data libraries for nuclear astrophysics reactions has been developed (see http://www.nucastrodata.org/). However, often the tabulated data are frequently out-dated, sometimes contradictory, and often tabulated in a wide variety of formats which makes it difficult for the astrophysics modeler to use.

CARINA (http://www.cyc.ucl.ac.be/CARINA/) is a collaboration network of European research groups to harmonize nuclear astrophysics research in Europe. CARINA is supported by EURONS through the 6th EC Research Framework Program (FP6). JINA (http://www.jinaweb.org/) represents a US collaboration between the University of Notre Dame, Michigan State University and the University of Chicago with several associated members in the US and Canada. JINA is funded through the Physics Frontier Center program of the National Science Foundation. Associated member in Europe is the ViSTAR virtual institute of the Helmholtz Society in Germany.

The goal of the collaboration between CARINA and JINA is to develop an updated and unified nuclear reaction data base for modeling a wide variety of stellar nucleosynthesis scenarios. The purpose of this meeting will be top develop strategies and techniques to update and eventually merge four of the presently most important data libraries.
KADONIS is a data library for slow neutron capture reactions or relevance for the s-process. The data basis is well maintained but the collaboration plans to expand it to also include photodisintegration reactions of relevance for the p-process.
NACRE is the main data basis for simulating stellar hydrogen and helium burning but is limited to low Z<14 only. The present data library needs to be up-dated since a multitude of new results has been obtained over the last ten years. The library needs also to be expanded to include charged particle reactions for higher Z which are important for shell helium and hydrogen burning as well as for explosive hydrogen burning in novae.
REACLIB is the main data base for explosive hydrogen and helium burning through the rp-process, which needs to be updated with recent results of radioactive beam experiments. The library contains also a large number of decay data information which needs to be completed.

The original authors of the three identified libraries are members of the CARINA-JINA collaboration and will take a lead role in the project. A further goal will be the development and implementation of a unified format in which the data of all libraries can be presented and used by the modeling community. This will be developed by the BNL and ORNL nuclear data community. The data library will be maintained and updated by the collaboration but will be made public through a website provided and hosted by the BNL nuclear data group.

During a first collaboration meeting at the University of Basel in June 2006 the collaboration agreed on the goals and procedure. The purpose of the ECT meeting will be to provide a one week closed working environment where subgroups of the participants will focus on reviewing and upgrading specific reaction information on the three identified libraries. The organization of subgroups and the assignment of the specific tasks will take place prior to the actual meeting.

5. Outline of the meeting

The following organization and assignment for the subgroups is envisioned (the conveners are in bold):

KADONIS: **I. Dillmann** , F. Domingo-Pardo, Z. Fülöp, S. Harrissopolos, M. Heil, F. Käppeler, A. Mengoni, R. Plag, E. Somorjai

NACRE: **C. Angulo**, A. Coc, H. Costantini, P. Descouvemont, J. Görres, W. Hammer, C. Iliadis, G. Imbriani, M. Wiescher,

REACLIB, charged particle rates: R. Hoffman, C. Iliadis, T. Rauscher, A. Sakarov, **H. Schatz**, M. Smith, F.-K. Thielemann, M. Wiescher

REACLIB, beta-decay rates: R. Hix, K.-L.Kratz, K. Langanke, **G. Martinez-Pinedo**, A. Sakarov

First day: presentations by the chairs of the working groups (Dillmann, Angulo, Schatz, Martinez Pinedo) on structure and format of the data libraries; additional presentations on recent up-grade efforts by C. Iliadis and P. Descouvemont; discussion on project assignments.

Second day: separate meeting of the four working groups
Third day: separate meeting of the four working groups
Fourth day: separate meeting of the four working groups
Fifth day: Progress reports of the working group chairs and discussion on further project development

6. List of the Participants (who expressed interest)

C. Angulo (Louvain la Neuve, Belgium)
M. Beard (Notre Dame, USA)
H. Costantini (U. Genova, Italy)
P. Descouvemont (UBL, Belgium)
I. Dillmann (U. Basel, Switzerland)
Z. Fülöp, (ATOMKI, Hungary)
J. Görres (Notre Dame, USA)
W. Hammer (Notre Dame, USA)

J. Hasper (TU Darmstadt, Germany)
M. Heil (GSI Darmstadt, Germany)
R. Hix (ORNL, USA)
G. Imbriani (U. Naples, Italy)
F. Käppeler (FZ Karlsruhe, Germany)
K.L. Kratz (MPI Mainz, Germany)
G. Martinez-Pinedo (GSI, Germany)
A. Mengoni (IAEA, Vienna, Austria)
P. Moeller (LANL, USA)
B. Pritychenko (BNL, USA)
T. Rauscher (U. Basel, Switzerland)
H. Schatz (MSU, USA
C. Scheidenberger (GSI, Germany)
M. Smith (ORNL, USA)
E. Somorjai (ATOMKI, Hungary)
K. Sonnabend (TU Darmstadt, Germany)
F.-K. Thielemann (U. Basel, Switzerland)
C. Ugalde (UNC Chapel Hill, USA)
M. Wiescher (Notre Dame, USA)
A. Zilges (TU Darmstadt, Germany)